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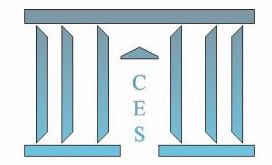

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2007.32

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Maison des Sciences Économiques, 106-112 boulevard de L'Hôpital, 75647 Paris Cedex 13
http://ces.univ-paris1.fr/cesdp/CES-docs.htm
ISSN : 1955-611X

A Role for Cultural Transmission in Fertility Transitions

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[1]I am gratefull to Bertrand Wigniolle, Thomas Seegmuller, David de la Croix, Jean-Olivier Hairault, Hypolite D'Albis and Victor Hiller for their precious help. Discussion with the participants of the workshop in macroeconomics of the EUREQua team has been very enlighting.

Abstract:

The paper proposes an economic and cultural mechanism that can predict a fertility transition and its timing. The cultural structure of the population is endogenously determined by a cultural evolution mechanism. The fertility rates reduction in the long run is always the result of an interaction between the cultural and economic structures of the society. Permanent productivity schocks have to distort sufficiently the cultural structure of the population to make acceptable modern behaviours (in term of fertility) to the traditionalist parents. An increase in the average income level provoked by the technological progress will be necessary but not sufficient condition to undergo a fertility transition. Finally, a fertility transition can always appear in the economy wathever the initial cultural structure but that cultural structure determines the timing of the transition.

Résumé:

Le papier propose un mécanisme économique et culturel qui peut prédire une baisse à long terme du taux moyen de fécondité et son timing. La structure culturelle de la population est endogène et déterminée par un processus d'évolution culturelle. La baisse du taux moyen de fécondité à long terme est toujours le résultat d'une interaction entre les structures économiques et culturelles de la société. Des chocs de productivité permanents doivent suffisamment distordre la structure culturelle afin de rendre acceptable les comportements modernes de fécondité aux agents traditionalistes. Une hausse du niveau de revenu moyen via les chocs de productivité sera une condition nécessaire mais non suffisante pour qu'une transition démographique puisse apparaître. Enfin, une transition démographique pourra toujours apparaître, quelque soit la structure culturelle initiale. Cependant, cette structure culturelle initiale détermine l'ampleur des chocs de productivité nécessaires.

1 Introduction

Explaining the fertility transition is not a novel topic. Economists and demographers provided some relevant theories in this field. The fertility transition can be defined as the transition from a traditional high birth rate regime to a modern low birth rate regime. From an economic viewpoint, at least two main explanations can be distinguished. Firstly, the beckerian costs advantages analysis shows that a trade-off between quantity and quality of children desired by parents can be induced by a change in the relative cost (or efficiency) of education and children rearing. Secondly, a risk analysis of fertility behaviours demonstrates that a children mortality variation can explain the fertility changes by a risk effect. According to Sah [1991] and Kalemli-Ozcan [2002], parents determine their optimal number of surviving children but rationally overshoot it because they forsee the die of some child born. The part of dead children is randomly determined by the children mortality rate, then the parental precaution demand for children increases with the children mortality.

Demographers and anthropologists propose some other explanations. An important one is the influence of culture and traditions on fertility choices. People belong to some cultural groups that embody specific norms and traditions directly affecting their economic behaviour. That impact has been highlighted by demographic and econometric studies.

Economists recently explored that phenomenon with econometric studies that directly measure the impact of traditions and religion (which are considered as good proxies for culture) on economic performance and sometimes especially on fertility behaviours[2]. Hacker [1999] shows that the degree of christian conservatism (measured by a dummy variable indicating wether individual belong to special religious groups such as Congregationalists,

[2]Note that in a macroeconomic perspective Max Weber paved the way with his "The Protestant Ethic and the Spirit of Capitalism". Barro and Mc Cleary [2002] find that economic growth responds positively to the extent of some religious beliefs but negatively to church attendance in an international panel of countries.

Universalists, Lutherans, Catholics...) is a good proxy for religion sentiment in the nineteenth century American native white woman. He finds that this proxy have a significant effect on the women's fertility: more conservatism implies a higher total fertility rate.

Fernandez and Fogli [2005] show that culture is important to two economic outcomes: female work and fertility. They observe the economic behaviour of immigrants to the United States during the second half of the twentieth century. They consider the expected female labor force participation and their total fertility rate, for the year 1950 in the immigrant's country of origin, as a good proxy for culture. It reflects their country cultural attitude toward women's labor and fertility. They find that the cultural proxy is an economically and statistically significant variable to explain women labor force participation and their total fertility rate. This effect remains robust after controlling for usual variables like income, social background... and for the bias of unobservable human capital differences and network quality heterogeneity.

Janssen & Hauser [1981] study fertility behaviours in the Wisconsin in 1975. They use a data set of seven thousand married people having children and being aged from 35 to 37. Their total fertility rate is regressed on their human capital (years of scholarship, diploma), their social background (job and human capital of their parents), their job status, their farmer status (to be a farmer or not,...), their age at marriage, their score at a specific IQ test and on their catholic status (to be catholic or not, to have a wife (husband) who is catholic, to have catholic parents). Then, after having controlled for all known biais, they find that to be catholic have a positive and significant effect on the agent's fertility. Catholics have from 0,5 to 1 more children than the non catholics.

Regarding these evidences, the paper proposes a model where people are culturally heterogenous. Agents can belong to a traditional culture (not especially a religion) characterized

by a high birth rate norm or to a modern culture (not especially the occidental one) characterized by a low birth rate norm. Utility functions make costly a deviation from the fertility norm of the group.

Furthermore the cultural structure of the population is not exogenous. It is the result of an endogenous cultural evolution mechanism. To obtain such a mechanism, the theory of endogenous preferences formation is employed. The paper especially follow the line of Bisin and Verdier [2001] where preferences are acquired through some socialization mechanisms. During the socialization process, parents try to transmit their preferences to their children because they prefer to have children like them. That preference can be justified in many ways.

Bergstrom [1994] explores the human evolutionnary history to analyse the family economics. He highlights that sexual diploids give a higher value to the siblings characterized by the same genetic trait as his own. He uses the Semi-Kantian Golden Rule for Sexual Diploid Siblings and the Hamilton Rule: *""Act toward your sibling as would be in your own best interest if with probability 1/2 your sibling's action would mimic your own" (...). Hamilton's rule implies that when faced with the option of sacrificing c units of its own reproductive success in order to increase the success of a relative whose coefficient of relatedness is k, by b units, the decision maker should make the sacrifice if it passes the benefit-cost test kb* $> c$*".* The Kantian Golden Rule implies that parents prefer to have non mutant children. When parents can not immediately discriminate between mutant and non mutant children, the Hamilton rule ensures that they take care of future mutant children if the probability that one child is a mutant is strictly inferior to one[3]. So Bergstrom proposes an evolutionary justification to the parental preference for children adopting their own trait.

[3]If the probability that a child is a mutant is one, parents do not take care of that child. They allocate their ressources to related children of other families who are not mutant with probability one.

Bisin & Verdier [2001] argue that parents prefer to have children adopting the same preferences as their own by the paternalistic altruism theory. A paternalistic parent values his children future behaviour through the filter of his own preferences. The optimal children's future behaviour maximizes the parental utility function only when these children have the same preferences as their parents. Then parents make some altruistic effort to transmit their preferences to their children. So Bisin & Verdier proposes an argument of imperfect empathy to justify the type of preferences used in this model.

In a sociological perspective, agents tend to be matched with other agents having the same trait, then there exist some social costs to have children adopting a different trait, their own social group punish them. A deviation from the norm of his social group is costly for a parent.

As parents prefer to have children adopting the same preferences as their own, they make a socialization effort. The model uses a standard socialization process with two stages, as in Bisin & Verdier [2001]. During the first stage, parents make an effort (e_t) to socialize their child to their own trait. If they do not succeed, during a second stage of socialization, the child is matched with an agent and adopt his trait.

In that framework, the fertility rates reduction in the long run is always the result of an interaction between the cultural and economic structures of the society. Permanent productivity shocks have to distort sufficiently the cultural structure of the population to make acceptable modern behaviours (in term of fertility) to the traditionalist parents. An increase in the wage gap between moderns and traditionalists level provoked by an asymetric technological progress will be a necessary but not sufficient condition to undergo a fertility transition. Finally, a fertility transition can always appear in the economy wathever the cultural structure but that cultural structure determines the timing of the transition.

The rest of the paper is organized as follows: the first section describes the structure of the economy and the microeconomic behaviour of each type of agent in the population. The second section analyzes the cultural and demographic dynamics of the economy. Finally the results are discussed.

2 Description of the economy

2.1 The Economy Model

The model consists in an overlapping generation economy where there are L_t agents who live for two periods. In the first period they are children, they only receive education from their parent and do not consume. In the second period they are adult, they choose their optimal number of children N_t and their social education e_t (which is understood as the socialization effort that will be defined in the next section). Family are monoparental in order to simplify the results. Childbearing is costly, each child implies a cost $\eta > 0$. The socialization cost is noted $\gamma > 0$.

Agents are culturally heterogenous in the sense that they could belong to different cultural groups. There exist two cultures in the economy. The first culture is the *traditional* one and is characterized by a high fertility norm $\overline{N}$ and by a constant level of individual human capital h^t. The second culture is the *modern* one and is characterized by a low fertility norm $\underline{N}$ and a fix level of human capital h^m [4]. In order to reflect the impact of culture on microeconomic behaviours, a deviation from the group fertility norm will be costly. q_t represents the proportion of modern agents at the period t, then $(1 - q_t)$ is the proportion of traditional agents at that date.

A modern parent who has a modern child receives a payoff noted V^{mm}; if he has a traditional child, he receives V^{mt}. A traditional parent who has a traditional child receives

[4] Note that the human capital levels are exogenous.

V^{tt}; if he has a modern child, he receives V^{tm}. All things being equal, parents prefer to have children adopting the same culture (trait) as their own but they altruistically prefer that their children become rich. Their children future income is determined by their human capital h^m if they become modern and h^t if they become traditionalist.

$$\begin{array}{l} V^{mm} = \theta^{mm} + w^m h^m \\ V^{mt} = \theta^{mt} + w^t h^t \\ V^{tt} = \theta^{tt} + w^t h^t \\ V^{tm} = \theta^{tm} + w^m h^m \end{array} \tag{1}$$

$\Delta V^m = \theta^{mm} - \theta^{mt} + w^m h^m - w^t h^t$ represents the loss for a modern parent to have a traditionalist child. $\Delta V^t = \theta^{tt} - \theta^{tm} - [w^m h^m - w^t h^t]$ represents the loss for a traditionalist parent to have a modern child. Note that parameters θ^{ij} are such that $\Delta V^m \geq 0$ and $\Delta V^t \geq 0 \ \forall i, j$.

The cultural trait a child will adopt is not exogenously determined, it is the result of a socialization process where the cultural education, provided by the parent, is crucial. A child is first exposed to the familial socialization that succeeds with probability $\tau\left(e_t^i\right)$ such that:

$$\tau\left(e_t^i\right) = \begin{cases} 0 \quad if \quad e_t^i < 0 \\ 1 - \left(1 - e_t^i\right)^2 \quad if \quad 0 < e_t^i < 1 \\ 1 \quad if \quad e_t^i > 1 \end{cases} \quad \forall i = m, t \quad with \quad \tau'\left(e_t^i\right) > 0, \tau''\left(e_t^i\right) < 0 \tag{2}$$

The socialization effort is costly, each familial socialization unit costs $\gamma > 0$. It is considered as a public good in the family, when the parental effort is e, each child have the probability $\tau(e)$ to adopt his parent's trait. If the familial process fails, the child is engaged in a second stage of socialization where he is randomly matched with a role agent in the society and adopt his trait. With probability $\phi(q)$ the child is matched with a mod-

ern agent[5] and with probability $1-\phi(q)$ with a traditionalist agent. $\phi(q)$ is such that $\phi'(q)>0,\ \phi(0)=0$ and $\phi(1)=1$. The transition probabilities can be expressed as follows:

$$\begin{array}{l} P^{mm}=\tau\left(e_t^m\right)+\left[1-\tau\left(e_t^m\right)\right]\phi\left(q_t\right) \\ P^{mt}=\left[1-\tau\left(e_t^m\right)\right]\left[1-\phi\left(q_t\right)\right] \\ P^{tt}=\tau\left(e_t^m\right)+\left[1-\tau\left(e_t^m\right)\right]\left[1-\phi\left(q_t\right)\right] \\ P^{tm}=\left[1-\tau\left(e_t^m\right)\right]\phi\left(q_t\right) \end{array} \tag{3}$$

$P^{ij}\in[0,1]\ \ \forall i,j$, it represents the probability for a parent of type i to have a child of type j. It appears that the probability for a child to become modern [traditionalist] increases with the proportion of modern [traditionalist] agent in the economy.

Actually, there exist two instruments for traditionalists and moderns to ensure their reproductive success in the long run: their fertility rates and their socialization effort. With a high fertility rate, a group ensures a large application of its socialization process. Then it can make a lower socialization effort per family to ensure the same reproductive success than a group with a low fertility rate. Inversely, a group adopting a high socialization effort per family, needs a lower total fertility rate. The cultural dynamic of the economy is expressed with the dynamic of q_t :

$$q_{t+1}-q_t=\frac{q_tN_t^m\left(1-q_t-P^{mt}\right)-\left(1-q_t\right)N_t^t\left(q_t-P^{tm}\right)}{q_tN_t^m+\left(1-q_t\right)N_t^t} \tag{4}$$

The demographic dynamic entirely depends on the cultural dynamic such that:

$$\frac{L_{t+1}-L_t}{L_t}=q_tN_t^m+\left(1-q_t\right)N_t^t-1 \tag{5}$$

The transition probabilities and the fertility levels crucially depends on the parental microeconomic choices that are described in what follows.

[5] $\phi(q)$ is not necessarily equal to q , it allows to depict every type of social discrimination and domination.

2.2 Microeconomic Choices

Following the precedent assumptions, the maximization program of a modern parent born at period $(t-1)$ is:

$$\begin{cases} \underset{N_t^m, e_t^m}{Max} W_t^m\left(N_t^m, e_t^m\right) = -\frac{1}{2}\alpha^m\left(\underline{N} - N_t^m\right)^2 + P^{mm}V^{mm} + P^{mt}V^{mt} \\ (st) \\ w_t^m h^m = \eta N_t^m + \gamma e_t^m \\ P^{mm} = \tau\left(e_t^m\right) + \left[1 - \tau\left(e_t^m\right)\right]\phi\left(q_t\right) \\ P^{mt} = \left[1 - \tau\left(e_t^m\right)\right]\left[1 - \phi\left(q_t\right)\right] \end{cases}$$

α^m represents the coercitive power of the norm $\underline{N}$ into the modern group. $\eta > 0$ is the quantity cost for each child born. $\gamma > 0$ is the cost of the socialization effort. The optimal behaviour of modern parents is:

$$N_t^m = \frac{\alpha^m \underline{N} - 2\left[1 - \phi\left(q_t\right)\right]\Delta V^m \frac{\eta}{\gamma}\left[1 - \frac{w_t^m h^m}{\gamma}\right]}{\alpha^m + 2\left[1 - \phi\left(q_t\right)\right]\Delta V^m \left(\frac{\eta}{\gamma}\right)^2} \tag{6}$$

$$e_t^m = \frac{1}{\gamma}\left(w_t^m h^m - \eta \frac{\alpha^m \underline{N} - 2\left[1 - \phi\left(q_t\right)\right]\Delta V^m \frac{\eta}{\gamma}\left[1 - \frac{w_t^m h^m}{\gamma}\right]}{\alpha^m + 2\left[1 - \phi\left(q_t\right)\right]\Delta V^m \left(\frac{\eta}{\gamma}\right)^2}\right) \tag{7}$$

The optimal fertility choice of a modern parent increases with the fertility norm $\underline{N}$ and with its coercitive power. ΔV^m can be understood as the modern parental intolerance that is to say the loss for a modern parent to have a child who adopt the traditionalist culture. An increase of ΔV^m consist in a higher expected loss per child born, then parents tend to make less children and to implement a higher socialization effort to reduce that expected loss.

The socialization effort decreases with the proportion of modern parents. The vertical (parental) socialization and the oblique (second stage of) socialization are substitutes. When

the parental socialization fails, a child with modern parents still have a chance to become modern if he is matched with a modern role agent in the society. When q_t increases, the probability for any child to be matched with a modern role model becomes higher. Then the expected gain per child born increases and parents can reduce their own (costly) socialization effort and make more children.

An increase of the modern wage can be ambiguous. Parents are supposed to perfectly anticipate the wage level of a future modern or traditionalist child. If a modern parent anticipates that w^m will increase for the next period, his expected loss per child born increases, then he reduces his fertility rate and increases his socialization effort.

However, if the modern wage increases for the modern parents *and* the future modern children, two effects are in balance. The higher expected loss effect is still present but an income effect takes place. The income of modern parents increases, that incites them to increase their socialization effort and their fertility. Then the net impact of a rise in w^m is still positive on e_t^m but is ambigous on N_t^m. It appears that for high values of w^m, the income effect becomes higher than the intolerance effect, then the quantity of children increases.

In a symmetric way, the maximization program of a traditionalist parent is:

$$\begin{cases} \underset{N_t^t, e_t^t}{Max} W_t^t\left(N_t^t, e_t^t\right) = -\frac{1}{2}\alpha^t\left(\overline{N} - N_t^t\right)^2 + P^{tt}V^{tt} + P^{tm}V^{tm} \\ (st) \quad w_t^t h^t = \eta N_t^t + \gamma e_t^t \\ \qquad P^{tt} = \tau\left(e_t^t\right) + \left[1 - \tau\left(e_t^t\right)\right]\phi\left(q_t\right) \\ \qquad P^{tm} = \left[1 - \tau\left(e_t^t\right)\right]\phi\left(q_t\right) \end{cases}$$

The costs of fertility and socialization are the same for traditionalist parents and modern parents. The optimal behaviour of traditionalist parents is symetric to the modern one:

$$N_t^t = \frac{\alpha^t \overline{N} - 2\phi\left(q_t\right) \Delta V^t \frac{\eta}{\gamma} \left[1 - \frac{w_t^t h^t}{\gamma}\right]}{\alpha^t + 2\phi\left(q_t\right) \Delta V^t \left(\frac{\eta}{\gamma}\right)^2} \tag{8}$$

$$e_t^t = \frac{1}{\gamma}\left(w_t^t h^t - \eta \frac{\alpha^t \overline{N} - 2\phi\left(q_t\right) \Delta V^t \frac{\eta}{\gamma} \left[1 - \frac{w_t^t h^t}{\gamma}\right]}{\alpha^t + 2\phi\left(q_t\right) \Delta V^t \left(\frac{\eta}{\gamma}\right)^2}\right) \tag{9}$$

The vertical and oblique socialization are still substitutes for traditionalists parents, then an increase in q_t incites them to make less children and to implement a higher socialization effort. A rise in w^t have the same impact for traditionalist parents as an increase in w^m for modern parents.

A rise in w^m reduces the expected loss of a traditionalist parent when his children become modern because their future income gain will be higher. Then traditionalist parents become less intolerant when their children adopt the modern culture. Actually they reduce their socialization effort and increase their fertility rate.

Following these microeconomic results, the cultural and demographic properties of the economy can be analyzed.

3 Scenario for a fertility transition

3.1 Analytical results

The cultural dynamic of the population is given by equations $(1), (3), (6), (7), (8)$ and (9). It follows, for interior solutions for equations $(6), (7), (8)$ and (9) for the traditional and modern programs, that:

$$q_{t+1} - q_t = \frac{q_t\left(1-q_t\right)\left(N_t^m - N_t^t\right) + \left(1-q_t\right)N_t^t P_t^{tm} - q_t N_t^m P_t^{mt}}{q_t N_t^m + \left(1-q_t\right)N_t^t} \tag{10}$$

$$with:$$

$$\frac{N_t^t P_t^{tm}}{\phi\left(q_t\right)} = \frac{\alpha^t \overline{N} - 2\phi(q_t)\Delta V^t \frac{\eta}{\gamma}\left[1-\frac{w_t^t h^t}{\gamma}\right]}{\alpha^t + 2\phi(q_t)\Delta V^t\left(\frac{\eta}{\gamma}\right)^2} \cdot \left(1 - \frac{1}{\gamma}\left[w_t^t h^t - \eta \frac{\alpha^t \overline{N} - 2\phi(q_t)\Delta V^t \frac{\eta}{\gamma}\left[1-\frac{w_t^t h^t}{\gamma}\right]}{\alpha^t + 2\phi(q_t)\Delta V^t\left(\frac{\eta}{\gamma}\right)^2}\right]\right)^2$$

$$\frac{N_t^m P_t^{mt}}{1-\phi\left(q_t\right)} = \frac{\alpha^m \underline{N} - 2[1-\phi(q_t)]\Delta V^m \frac{\eta}{\gamma}\left[1-\frac{w_t^m h^m}{\gamma}\right]}{\alpha^m + 2[1-\phi(q_t)]\Delta V^m\left(\frac{\eta}{\gamma}\right)^2} \cdot \left(1 - \frac{1}{\gamma}\left[w_t^m h^m - \eta \frac{\alpha^m \underline{N} - 2[1-\phi(q_t)]\Delta V^m \frac{\eta}{\gamma}\left[1-\frac{w_t^m h^m}{\gamma}\right]}{\alpha^m + 2[1-\phi(q_t)]\Delta V^m\left(\frac{\eta}{\gamma}\right)^2}\right]\right)^2$$

This dynamics is non linear and very dependant on the parameters value, some interesting properties appears. There always exist at least two steady states $q_t = \{0, 1\}$, that comes from the implemented socialization process: $P^{tm} = 0$ when $q_t = 1$ and $P^{mt} = 0$ when $q_t = 0$. It ensures that no "cultural mutation" can appear: if a trait is not represented in the society, it will never be represented in the long run unless it is exogenously intoduced. These two steady states are not necessary stable.

The non linearity of the dynamics implies that the number of steady states and their stability crucially depend on the parameters values. No general result can be proposed excepted that bifurcations could appear. To obtain more tangible results, a calibration and simulation exercise is proposed.

3.2 Numerical Results

A calibration and simulation exercise is proposed. The calibration values are given in appendix 1. $\phi\left(q_t\right)$ is choosen to reflect a social domination mechanism. The culture in majority controls some strategic social instruments that make the child probability to be matched with a role agent of the dominant culture greater than their proportion in the population. $\phi\left(q_t\right) = q_t^3 - \frac{3}{2}q_t^2 + \frac{3}{2}q_t$. It can be supposed that the dominant culture influences the social-

ization mechanism with instruments like school, public structure for child rearing...

The model is not a general equilibrium model: it does not present the parental consumption behaviour, the human capital accumulation and the industrial structure. Traditionalists and moderns exhibit the same human capital endowment: $h^t = h^m = 1$ constant for all t. The exercise objective is to show that a cultural and demographic transition does appear when the wage of modern parents increases and when the traditionalist culture is not too coercitve. The coercitivness of a culture is measured by two parameters: α^i and $\theta^{ii} - \theta^{ij}$.

The first calibration exercise considers that the traditionalist and the modern culture have the same (low) intolerance (coercition): $\alpha^m = \alpha^t = 1$ and $\theta^{mm} - \theta^{mt} = \theta^{tt} - \theta^{tm} = 10$; The cultural dynamic is simulated for $w^t = 1$ and $w^m = \{0.5, 1, 4, 10\}$. In other words, permanent asymetric productivity shocks are simulated, only w^m is affected. Then it is assumed that the labour market does not value in the same way the two kind of human capital. When a positive permanent technological shok does appear, the wage gap between moderns and traditionalists increases.

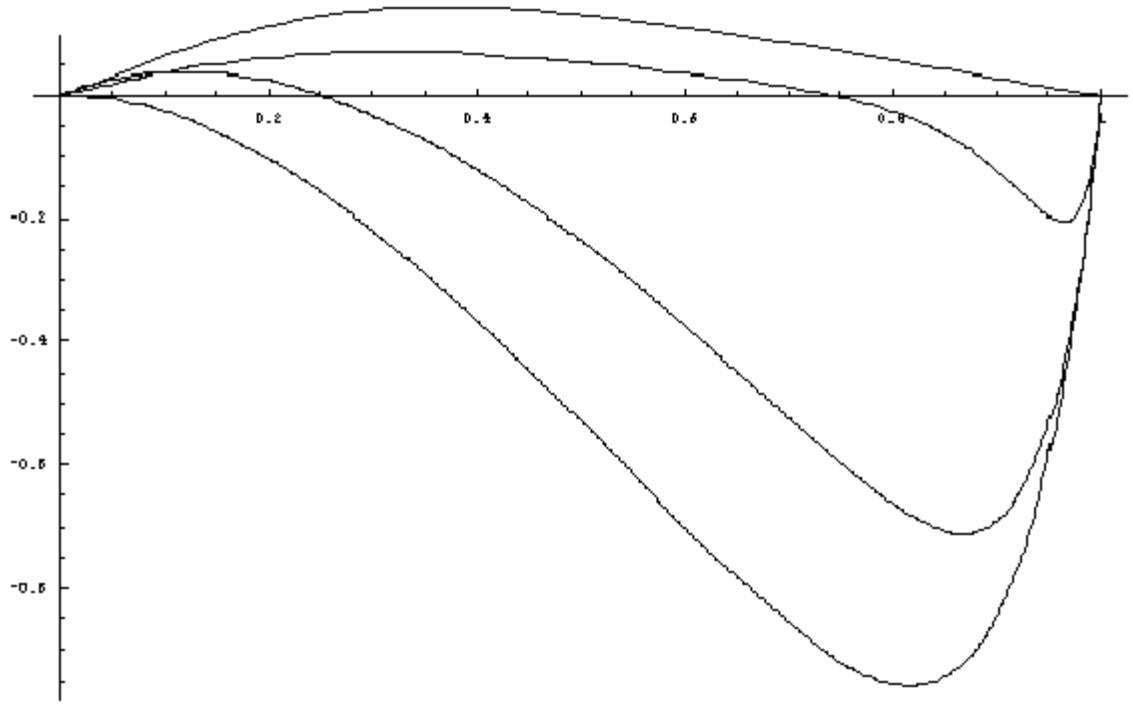

Figure 1: Cultural Dynamics in Presence of Wage Gap Schocks

It appears that an increase in the modern wage level implies a higher proportion of modern agents in the long run. Moreover transcritical bifurcation does appear: for low levels of modern wages, there only exist two steady states $q_t = \{0, 1\}$ and only $q_t = 0$ is stable, for intermediary level of w^m a third steady state appears, that steady state is the only one to be stable. Finally, for very high values of w^m, there only exists two steady states $q_t = \{0, 1\}$ and only $q_t = 1$ is stable.

An increase in w^m has two main effects: it changes the expected loss of modern and traditionalist parents if their children do not adopt their own culture, and it increases the modern parents income. A higher w^m implies that to be modern is more enjoyable for each people, then the intolerance of modern people increases whereas the intolerance of traditionalist people decreases. Traditionalists tend to make more children with a smaller socialization effort. When the increase of w^m is high, the traditionalists socialization effort

tends to zero, then their children are directly matched with a role agent. The moderns tend to make less children with a higher socialization effort because they are more intolerant (ΔV^m rises). However, a higher w^m means an higher income for modern parents, then they tend to make more children with a higher socialization effort. For a very high increase in w^m, that income effect could dominate the intolerance effect. Then the proportion of modern agents in the long run positively depends on the level of w^m and there exist some parametric configurations where the modern culture is the only one that is stable in the long run.

The fertility transition is defined as a transition from a high births rate steady state to a low births rate steady state. A sufficiently high increase in w^m provokes a transition from a steady state where traditionalists are in majority to a steady state where moderns are in majority. The model shows that traditionalists exhibit a higher fertility rate than the moderns. Then the cultural transition unambigously implies a fertility transition. A transition from $w^m = 1$ to $w^m = 10$ can be represented by the following evolution of the average total fertility rate:

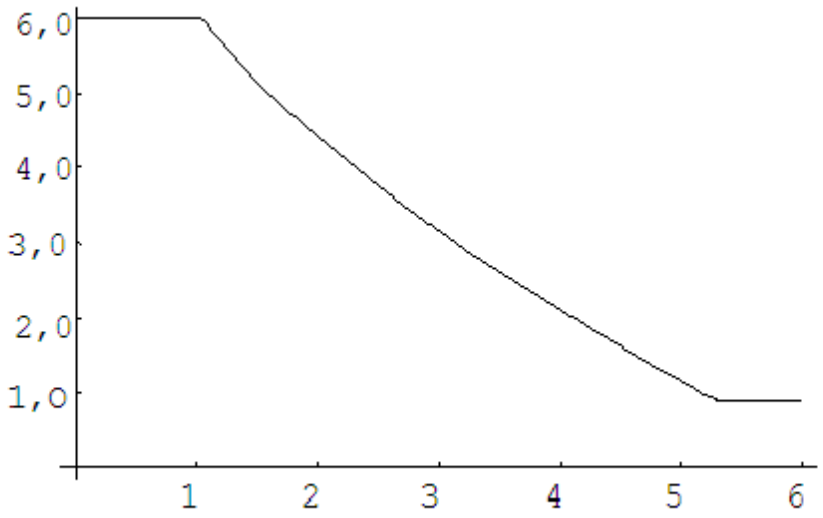

Figure 2: Average Net Fertility with a Large Wage Gap Schock

A second simulation exercise is implemented. The cultural intolerance of the traditionalist group is now higher than the intolerance of the modern group, such that $\alpha^m < \alpha^t$ and $\theta^{mm} - \theta^{mt} < \theta^{tt} - \theta^{tm}$. No significative cultural and demographic transition does appear for $w^m = \{0.5, 1, 4, 10\}$. It results from the decrease of the traditionalist sensibility to the modern wage increase. If the traditionalist agents exhibit a very high cultural intolerance, they are not sensible to the income improvement their child could enjoy if they become modern. Then their socialization effort does not necessary tend to zero when w^m increases and no significative transition does appear. The transition will appear for very high values of w^m that will be more difficult to reach.

However, for higher values of w^m, the same result is obtained. It is just required that w^m goes from 1 to 22.

4 Discussion and Conclusion

The model shows that a fertility transition could not appear without a cultural transition. The apparition of a fertility transition is always the result of an interaction between an economic and cultural evolution. Furthermore, a fertility transition can always appear in that framework. Given the cultural structure of the population, a sufficiently large productivity shock provokes a fertility transition. That productivity shock has to increase the wage gap between the cultural groups such that the cultural deviation becomes more acceptable. As a result, the apparition of productivity shocks is not a sufficient condition to undergo a fertility transition. For very large shocks, the cultural deviation becomes an optimal choice for a group and that group disappears in the long run.

That result already exists in the demographic litterature. Chesnai [1986] shows that the increase in the human capital endowment provokes a decrease in the religious sentiment.

That phenomenon implies a fall in the net fertility rates. Then a fall in the intensity of religious sentiment does not appear as a necessary and sufficient condition to undergo a demographic transition. It only appears as a necessary one.

Finally, the model predicts that two economically similar countries affected by the same technological shock will not experience the same fertility dynamics if their cultural structures are different. A country with a more coercitive traditional culture will experience a lower reduction in its fertility rate than a country with a less coercive traditional culture.

Gaisie [1996] shows that some Sub-Saharan African countries as Cameroon, Mali and Nigeria do not achieve their demographic transition because of cultural pressures. These countries experienced a fall in their children mortality rates and developed educational politics but do not significantly reduce their fertility rates. That explanation is in line with Mekonnen and Mekonnen [2002], Addai [1998] and Mekonnen [1998].

In conclusion, the model and its calibration exercise seem to confirm an argument of many demographers: a fertility transition could appear only if the cultural structure of the society can accept it. It shows that, if traditionalism is defined by a high births rate norm, a low degree of coercition in the traditional group is a necessary but not sufficient condition to undergo a fertility transition. A fertility transition is provoked by the co-existence of favourable economic and cultural conditions. In that sense, the paper improves the existing litterature on demographic economics by introducing a cultural background in an endogenous fertility model. It does not explain the fertility behaviour changes by a pure human capital argument or inversely by a simple exogenous change in the agent's preferences. It proposes a mechanism where the improvements in the human capital returns provokes a cultural mutation allowing the implementation of a fertility transition.

Future research will have to endogenize the process of human capital accumulation. Then

the model could propose a specific explanation to the early development of developed economics and the late development of other countries.

Appendix 1

Common Values

$$h^t = h^m = 1$$

$$w^t = 1$$

$$\eta = 30$$

$$\gamma = 30$$

Fertility Norms (from Bairoch [1999])

$$\underline{N} = 1$$

$$\overline{N} = 4$$

First Exercise

$$\theta^{mm} = 20$$

$$\theta^{mt} = 10$$

$$\theta^{tt} = 20$$

$$\theta^{tm} = 10$$

$$\alpha^m = \alpha^t = 1$$

$$w^m = \{0.5, 1, 4, 10\}$$

Second Exercise

$$\theta^{mm} = 20$$

$$\theta^{mt} = 10$$

$$\theta^{tt} = 40$$

$$\theta^{tm} = 10$$

$$\alpha^m = 1$$

$$\alpha^t = 3$$

$$w^m = \{0.5, 1, 4, 10, 22\}$$

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